



Scenarios as a tool for Integrated Coastal Zone Management (ICZM) – how to handle the aspects of quality of life?

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Abstract

Using the German North Sea coast as an example for changing use patterns, the article describes the scenario approach used in the BMBF-funded research project “Zukunft Küste – Coastal Futures” as a tool for an integrated assessment of potential coastal developments. The approach examines a range of different scenarios or pathways for future development of the German North Sea region in order to describe potential changes in marine use patterns. The scenarios are based on the Driver-Pressure-State-Impact-Response (DPSIR) model. The purpose of the scenarios is to describe the consequences of different sea use patterns in terms of regional development, coastal socio-economic structure and social infrastructure as well as marine ecosystem impacts. The paper focuses on criteria that can be used to assess social states and impacts based on a spatial approach. Here, infrastructural living conditions are described. Some indicators, figures and underlying data are presented.

1 Background and Motivation

In recent years, ever more industries have competed for the use of the marine ecosystem. Fisheries, oil and natural gas production, gravel and sand extraction remove raw materials, the military deploys forces in the area for training purposes, and shipping, telecommunication and the oil and natural gas industry use the sea as transit space for goods, data and raw materials. Additionally, parts of the sea and coast are protected due to their high biodiversity and sensitivity. Most importantly perhaps, multiple interactions exist between marine and land uses. Shipping needs access to the mainland, resulting in the decline or development of harbours depending on the state of the industry. Vice versa, many land-based uses take advantage of the sea, such as coastal tourism which benefits from the sea as a recreational factor. Despite these high levels of pressure, utilization of marine resources shows no signs of levelling off. On the contrary, new uses seem to rapidly conquer the marine environment, amongst them offshore wind energy, hydrogen production or mariculture.

All forms of marine and coastal resource use have impacts on the marine and coastal system. These include ecological impacts in terms of the ecological integrity of the system, economic impacts through specific branches of industry, and on social systems in terms of quality of life and social infrastructure in coastal areas. New industries for instance generate new onshore (and also offshore) jobs, with impacts on local demographic development. This in turn influences the need for social infrastructure such as education, health, housing etc.

How can these developments and cause-effect relationships be described if new spatial uses emerge in a certain area? What influence do newly emerging uses have on other uses or on the existing ecological and socio-economic systems? What interplays generally exist between certain sea uses and coastal uses, between human activities and coastal ecosystems? These are some of the questions addressed by the federal research project ‘Zukunft Küste - Coastal Futures’, funded by the German Federal Ministry of Education and Research. Spatially, the project focused on the North Sea and more specifically on the West coast of Schleswig-Holstein.

To be able to estimate the consequences caused by anthropogenic pressure on the marine and coastal environment on the Schleswig-Holstein coast, different future scenarios were developed for the German North Sea coast up to 2055. Scenarios are a useful method to depict complex cause-and-effect relationships or systems interactions (for example climate change) and to explain the impacts of change on the environment or humans (Alcmo 2001, Alcmo & Bennet, McCarthy et al. 2001, Alley et al. 2007, Rotmans et al. 2001, Shell 2002, UNEP 2002, WBCSD 1997).

Scenarios illustrate plausible, possible, alternative futures which could happen under certain assumptions. They are not to be confused with long term forecasts or predictions of future developments. As tools scenarios help to deal with uncertain futures by identifying cause-and-effect relationships and estimating the results of certain developments. This is of particular benefit to decision-makers. Put simply, scenarios can be imagined as descriptions of different versions of the future. They are encapsulated in so-called storylines, which not only describe the world in the year x , but also explain what ecological, economic and social changes are linked to this future. Once the storyline is completed, it is nailed down with model calculations or data.

The biggest challenge for the development of scenarios is the description and definition of the systems they are to relate to (ecology, economy, quality of life / social system). In ecosystem research suitable indicators exist to describe the system in terms of the nutrient and energy budget, the ecological structures and biotic and abiotic dynamics. Economic well-being can be described through characteristics of macroeconomic accounting, which cover all aspects of employment and income. It is, however, by far more difficult to find suitable indicators for describing the social system. Quality of life, for example, is both a matter of individual perception and also of objective infrastructure conditions. The following presents results obtained during scenario development within the project 'Coastal Futures'. The main focus will be on the methodology that was used to describe the effects of changes in sea and land use on the quality of life of the population on the West coast of Schleswig-Holstein. Data is presented where possible, and a first overview is given of the current status of living conditions on the West coast.

It is of great note for decision-makers to know the effects of different economic developments on the public, for example the impacts on employment. However, the creation or loss of employment in a region in turn impacts on living conditions.

2 Location and Methods

The DPSIR-Modell

The scenarios in Coastal Futures were based on the Driver-Pressure-State-Impacts-Response-Model (DPSIR approach) (EEA 1999). It was also decided to use an anticipatory approach, which means that a future vision is developed first, followed by a retrospective analysis of steps that would lead to this future (see Burkhard 2006). The DPSIR model allows a structured, easy and gradual approach to the future visions and structured presentation of cause-and-effect relationships. Figure 1 shows the sequence of steps which are connected as follows: *Drivers* are driving forces that lead to pressure, in this instance on an area or territory. A need for raw materials or energy could be a possible *driver*, as can certain societal norms and values. Thus a more technology - oriented society might tend towards greater individual innovation and willingness to take risks, whilst a society that values "ecological thinking" might be more likely to support more careful and sustainable use of the environment. These *drivers* cause certain changes in existing land and sea use patterns. Thus some uses decline in comparison to others, some are strengthened or new ones are added. These land and sea uses – human impacts effectively - are called *pressures*. Changes in onshore and offshore uses affect the existing ecological, economic, social systems (*state*) which will probably be altered too (*impacts*). Changes in the systems described cause societal reactions which are termed *responses*.

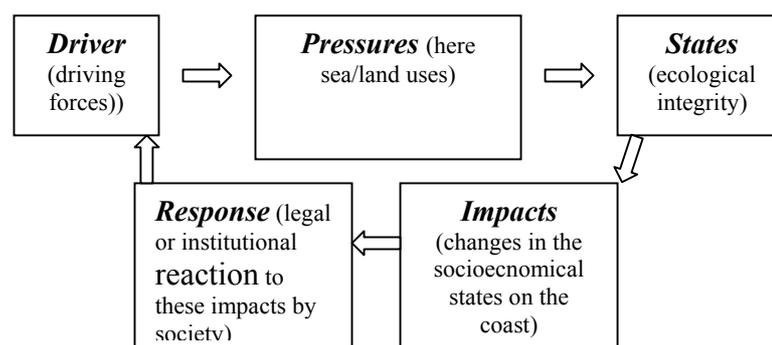


Figure 1: DPSIR-Model in the context of the scenario development by the project Coastal Futures

What might possible futures of the North Sea (coast) be in 2055? Altogether five different visions of the future were developed in the project, which show different priorities of marine uses:

- A) Sea and coast as a predominantly natural area
- B) Sea and coast as a source for renewable energies
- C) Sea and coast as a predominantly industrial area
- D) Sea and coast as a leisure and tourism area
- E) Sea and coast as a transport area

For these future visions 13 initial storylines were developed in a first step. In a second step five scenarios were chosen for complete processing. More detailed descriptions of *storylines*, *drivers* and *pressures* and the scenarios themselves can be found in Burkhard (2006), Burkhard & Diembeck (2006) and Licht-Eggert et al. (2007).

This article focuses on the description of the social system and the characterization of societal quality of life within scenario development.

Social system/quality of life

“Quality of life describes the amount of personal satisfaction. This grows with the fulfilment of desires and needs in a physical, spiritual, mental and material sense, with the current life situation as a starting point” (<http://www.stiftung-lebensqualitaet.de/> (16.8.2007)). There are two different approaches to measure quality of life: the “quality of life“ and the “level of living” perspective.

A) “quality of life“ perspective

The “quality of life” perspective stresses subjective perception and assessment processes in determining quality of life. It focuses on how social changes are subjectively perceived by the population and whether they are seen as improvement or deterioration. Humans themselves are seen as the best experts to judge their own quality of life which is understood here as individual well-being. To measure quality of life, mainly subjective indicators are used, such as the level of satisfaction and happiness. These can only be assessed subjectively by means of personal estimate. Surveys for instance include the national ‘Perspective Germany’, carried out regularly by the Federal office of Building and Regional Planning.

B) “Level of living approach“

In this approach quality of life is defined by a concept of control and resources. “Individuals command over, under given determinants mobilizable resources, with whose help he/she can control and consciously direct his/her living conditions” (Erikson 1974, p. 275, Erikson 1993, p. 72 ff.). A

person is seen here as “an active, creative being and the autonomous definer of his own end. The resources are a mere means to the latter.”

So-called individual resources are those that can be used to shape the desired individual living conditions. They are taken to include income and property but also education, social relationships as well as psychological and physical energy. Aspects that influence living conditions but defy individual control, such as the natural environment, health or infrastructure, are called determinants. It is the combination of resources and determinants which regulates individual living conditions. Operationalisation of this approach to quality of life primarily uses objective indicators.

The “regional planning report“ (Raumordnungsbericht) in 2005 (BBR 2005) links the description of objective living conditions to the spatial distribution of certain determinants and is used as a basis for determining quality of life in the Coastal Futures scenarios. In this approach quality of life is composed of economic determinants, such as income and employment, and infrastructural living conditions, such as health care, education, housing, leisure and cultural facilities, transport and security. The fundamental assumption is that every person can reach a certain level of satisfaction in their life, provided they can make a reasonable living (access to jobs) and have access to a range of basic services, such as housing, medical care, schools and kindergartens, sport and leisure facilities and cultural facilities. The regional spatial planning approach therefore establishes close links between the spatial distribution of basic infrastructure, access to basic services and quality of life.

The above-mentioned determinants of objective quality of life are influenced by changes in occupation (economic *impacts*) and by demographic change. Apart from natural population development age-specific internal migration is particularly relevant since these strongly contribute to population dynamics at the regional level. Because mobility is age-dependent, internal migration leads to changes in age composition of the population and therefore to changed demands in terms of objective living conditions. If, for instance, significant numbers of young professionals and their families move to a region, this will lead to increased demands for school and kindergarten places. To assess the required changes, the current situation of educational institutions in the region needs to be known. If, for example, current educational facilities are already pushed, i.e. there are not enough places in schools or kindergartens, then the situation would grow more acute if in-migration occurred as described. If, on the other hand, the current position is relaxed, i.e. enough facilities exist, in-migration to the region would not cause any problems.

The dimensions outlined above provide an indirect approach to well-being and satisfaction because they describe the structural preconditions for quality of life. Why is the described approach the right one for the quality of life description in the scenarios? First it is possible to figure spatial dimensions as it is done in the scenarios. With empirical enquiries you need a huge number of persons to make significant area-wide statements. Second the determinants of the living conditions could be supported by figures which are recorded by official statistics and needn't to be collected by extensive surveys. This is why the regional planning approach, i.e. the description of objective criteria for quality of life, was chosen for representing social state and impact within the Coastal Futures scenarios.

With respect to these scenarios the “conditions for quality of life” therefore need to establish to what degree the West coast of Schleswig-Holstein is able to provide suitable infrastructural conditions to achieve high quality of life and therefore, indirectly, high levels of satisfaction and personal well-being. It should be stressed that this scenario work can only indicate a need, providing useful information to politicians, but gives no instructions and recommendations on what decisions should be taken.

Figure 2 shows an amoeba representation of different categories chosen to represent objective quality of life. These are health care, education, security, culture and leisure, accommodation and transportation. In the following these categories are outlined in detail.

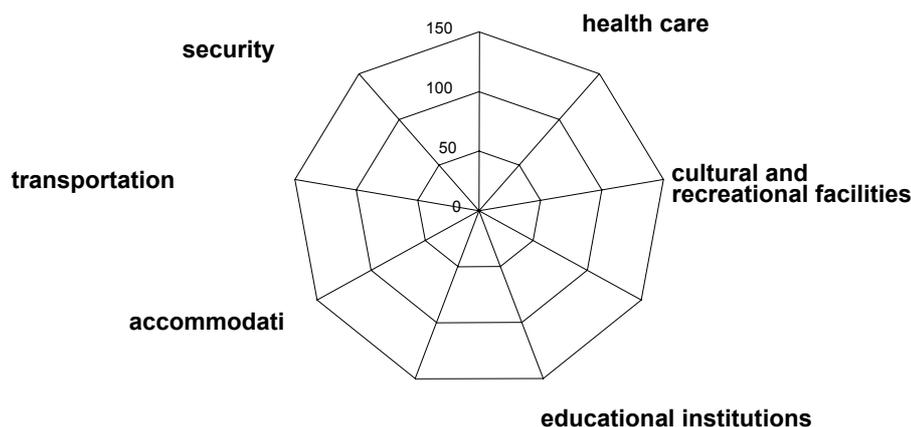


Figure 2: Categories used to describe objective living conditions (social state) in the “Coastal Futures“ scenario approach

3 Results

The following sections consider individual elements of the social states in greater detail. Indicators for describing availability and accessibility of these facilities are introduced. Finally an overview is given of the current state of the objective living conditions on the West coast of Schleswig-Holstein. Factors which influence these are discussed. Statistical data is provided where possible, all of which were obtained from the Federal Statistical Office or the regional authorities of Schleswig-Holstein (see literature).

3.1 Indicators and current states

Education

The category of “education” comprises a) the primary sector (pre-school, day-care centres, age group 0-6 years), b) the secondary sector (primary and secondary schools, special pedagogic schools, age group 6-approx. 18 years), and c) the tertiary sector (colleges, universities, age group > 18 years).

To evaluate the level of provision in the primary sector (day-care centres) the place/child ratio can be used as an indicator. This information, which is shown in statistical data according to age groups (<3 years, 3-6 years, 6-10/12 years), demonstrates the available places in the respective facilities in proportion to the total number of children in these age groups. In the amoeba representation (see figure 3), the kindergarten place / child ratio (age group 3-6 years) was selected as the lead indicator, because it is the only regularised one¹.

To evaluate the level of provision in the secondary sector the pupils/class ratio can be used as an indicator. This is calculated by the relevant authorities for every type of school (elementary school, secondary modern school etc.) and indicates the average number of pupils per class (if possible per type of school²). A minimum classes size of 25 pupils / class is demanded by the Federal Office for Building and Regional Planning (BBR 2005), providing a ready-made criterion for assessment. A minimum standard of 25 P/C is therefore taken as normal levels of provision, whilst ratios below 25 P/C are taken as failing to reach minimum standards. This indicator however can only be applied where regular classes exist, which is why secondary modern and grammar schools are excluded. To describe the level of educational infrastructure at the schools level on the West coast of Schleswig-Holstein, an averaged P/C ratio is used which takes into account all types of schools across all

¹ Within the Pregnant and Family help law in 1992 the Federation has fixed a legitimate claim to day care for third year old children up to their school enrolment. Responsible institutions of the public youth welfare have to guarantee full-day places or to give additional support in day care for this age group. (Statistisches Bundesamt 2004, p. 4).

² For Example in Germany the school system is classified in primary school (Grundschule) and several types of secondary schools like Hauptschule, Realschule or Gymnasium.

administrative districts. Literature offers no indicator to date to describe the level of provision at vocational school or university/college level. Therefore, the absolute data (number of students) (2002, 2003) are taken as 100 % and are referred to the spatially level (pupils of vocational schools are referred to the administrative districts, students are referred to the Länder level), but without an assessment for over- or undersupply. So what is the current situation with regards to educational institutions on the West coast of Schleswig-Holstein? There is

- an undersupply of day-care centres (P/C ratio for the administrative districts 72-80, compared to a German average of 78³), together with an
- above-average availability of schools (P/C ratios between 19 and 21).

It is not possible to assess whether there is adequate supply of vocational schools, colleges and universities.

Accommodation

To estimate whether the region provides adequate levels of housing, the supply-demand ratio can be used. If available housing is greater than current demand, the housing market is relaxed; if available housing is less than current demand the market is tense. The availability of housing (houses, flats, rooms for rent and for sale) is determined for statistical purposes by regular counts at intervals of several years.

Demand for accommodation can be measured through indicators taken from general population trends. It is a rough measure because the relevant sizes determining housing demand are households rather than individual persons. Household size and structure are estimated based on micro-censi, but are based on a projected sample and therefore only of limited use.

To estimate the housing market situation, the relationship of supply and demand is regarded. This can be done by comparing the proportional change of available housing (in absolute numbers) and the total population of the region. If the number of available housing (measured here as unoccupied accommodation) rises more strongly than the total population and the difference is not compensated by smaller household sizes (i.e. more one- or two-person households taking up the same amount of housing), the housing market relaxes, resulting in excess supply (Vaeser et al. 2005). The relative number of unoccupied dwellings can also be used to estimate supply and demand (as a proportion of excess supply). A relative number of more than 4 % of unoccupied dwellings clearly exceeds mobility reserves and must be regarded as problematic (Vaeser et al. 2005, p. 37).

A survey already exists of the housing market situation and its development in the context of demographic change in Schleswig-Holstein (Vaeser et al. 2005), which is taken as a basis for the scenario approach. For the West coast of Schleswig Holstein, a surplus of housing is assumed, reflecting the fact that available housing has risen faster than the population. In addition there is a remarkable share of detached houses compared to the county average. Dithmarschen, one of the West coast administrative districts, has a proportion of 73 % of detached houses compared to all housings counted in the district. The number of unoccupied dwellings amounts to 2 % (averaged of both administrative districts on the West coast). Hence, in the scenarios a 10 % surplus of housing is assumed as a state for 2005.

Health care

Guaranteeing adequate medical care to everyone is an important element in the public provision for human well-being. Medical care can be divided into outpatient and stationary care. General practitioners, physicians, dentists and specialists provide ambulatory care in surgeries, whilst stationary care is provided by hospitals, preventative and rehabilitation facilities. For the purpose of the present scenario development nursing homes are also considered part of the health care sector.

Indicators for stationary health care provision could be:

³ This means that 72-80 of 100 children get a place in a day-care centre averaged over the administrative district.

- Bed density (number of inhabitants per numbers of hospital beds), for which no minimum standard has been found,
- Hospital beds per 10.000 inhabitants. Here, Federal and Länder hospital statistics offer a good statistical basis. The values shown here are determined as follows: Hospital beds in 2002 / total number of inhabitants (relating to county, and/or Länder level) on 31.12.2002 x 10.000.

An indicator of ambulatory health care provision is the number of doctors per inhabitant or overall physician density. Physician density is expressed as numbers of physicians per 100.000 inhabitants. No general minimum values were found in the literature, but a comparison with Federal or Länder average gives first insights into the situation of medical care in the region. Thus the number in hospital beds per 10.000 inhabitants on the West coast of Schleswig-Holstein (averaged over both counties at the West coast) is about 12 % less than the Länder average of Schleswig-Holstein, and physician density is about 20 % lower compared to the Länder average.

Transportation, cultural and leisure facilities, security

Literature revealed no indicators or assessment criteria for describing the level of transport provision, supply with cultural and leisure facilities or security. No sufficient data was found to describe any of the above objective living conditions. “Good” public transport and sufficient supply of cultural and leisure facilities is likely to be irrelevant in terms of objective living conditions, but probably of high significance in terms of subjective well-being. Security is seen in connection with coastal protection in this context.

3.2 Current state of objective living conditions on the West coast of Schleswig-Holstein

The current objective living conditions on the West coast of Schleswig-Holstein are shown in figure 3. The amoeba has to be interpreted with the question in mind “how is the (current) care situation” with educational institutions, health care, housing, transportation system, security and cultural and recreational facilities at the West coast of Schleswig-Holstein? In the following this question is answered as far as it was possible by the available data situation (for example the lack of data for transportation system or cultural facilities).

To give an estimate of the current provision of health care physician density (outpatient care) and hospital beds per inhabitant (inpatient care) were averaged for both West coast districts and compared to the general Länder average of Schleswig-Holstein. Physician density, which is about 20 % below the Länder average, was therefore given a value of 80 % out of a possible 100 %, indicating an undersupply of 20 %. Levels of stationary care on the West coast are about 12 % below the Länder average of Schleswig-Holstein; hence, the value shown in the amoeba is 88 % out of a possible 100 % (baseline data for 2005). So it can be said that there is an undersupply of health care at the West coast of Schleswig-Holstein of approx. 20 % for outpatient care and 12 % for inpatient care. The supply with cultural facilities is fixed at 100 % because of the lack of indicators and data in this field. The supply with education is divided in several age groups. The P/K ratio of the day-care-centres (kindergarten), averaged for both West coasts districts, is calculated at 76 and can be seen as an undersupply of 76 % (76 of 100 children get a place at a kindergarten). S/K values (schools) which are between 20 and 25 are interpreted as slight surplus and assigned an arbitrary value of 110 %. Values between 15-20 are counted as surplus (120 %) and values of <15 as strong surplus (130 %). The present situation indicates a slight surplus (= 110 %) of schools on the West coast. The region’s provision of vocational schools and colleges was not assessed because of a lack of criteria, hence, current pupil and student data are simply put at 100 %. You see that the educational sector at the West coast shows a different situation with an undersupply of institutions for 3-6 year old children, a surplus of school places and no possible statements for universities and vocational schools. The assessment of housing provision is based on literature, which describes the situation on the West coast as “relaxed” (Vaeser et al. 2005). The current provision with accommodation is therefore set at 110 %.

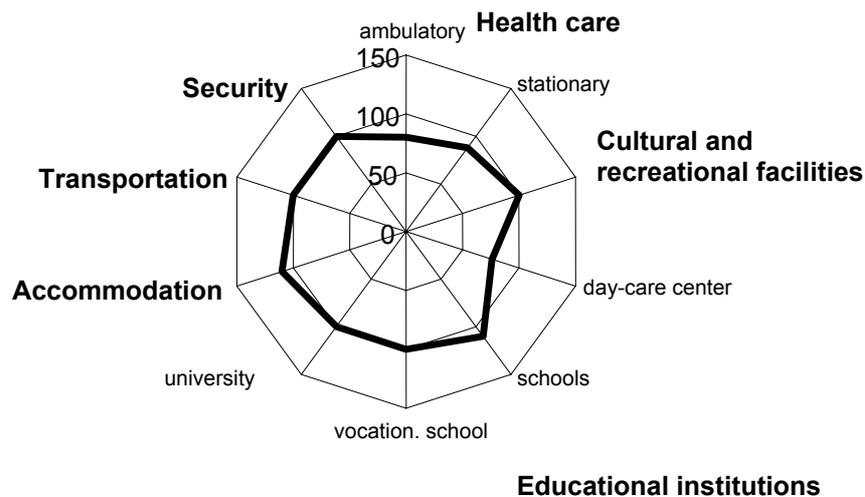


Figure 3: Current state of objective living conditions (social state) in 2005 on the West Coast of Schleswig-Holstein in the 'Coastal Futures' scenario approach

Some described fixed percentage above should be handled with care. The values for health care and day-care centres are easier to quantify than the percentage of the housing situation and provision with school places, which gives more a qualitative overview. For example the used percentage fixing for the housing could also have been fixed by 120 % surplus to "quantify" a "relaxed" situation.

3.3 Influence of demographic and economic change on objective living conditions

The infrastructural living conditions described above are affected by demographic change as well as changes in the economic situation of a region. These reciprocal effects are represented in figure 4 and are explained more in detail below. It demonstrates that the economic situation in a region indirectly affects living conditions by influencing in- and out migration, whereas demographic change and migration have effects on several aspects of infrastructural well being.

Using the increase or decrease in the number of employed persons as an indicator for economic impacts, the effects of job creation in the region on demographic change could be measured in terms of job seekers moving into the region or people moving away. Any increase in employed persons naturally also affects the age structure and age distribution of the regional population.

Demographic change also clearly influences the objective living conditions. For the West coast of Schleswig-Holstein a natural population decline is predicted (negative population growth), which is unlikely to be compensated by migration into the region. Society is therefore set to age, with a strong decrease in the subpopulation of below-20-year-olds and a strong increase of those over 50. This leads to the assumption that the demand for educational facilities for 3- to 20-year-olds will decrease, whilst there is likely to be an increase in the demand for health care facilities to meet the needs of an older population. Changes in age groups combined with modifications in migration also have impacts on the housing market.

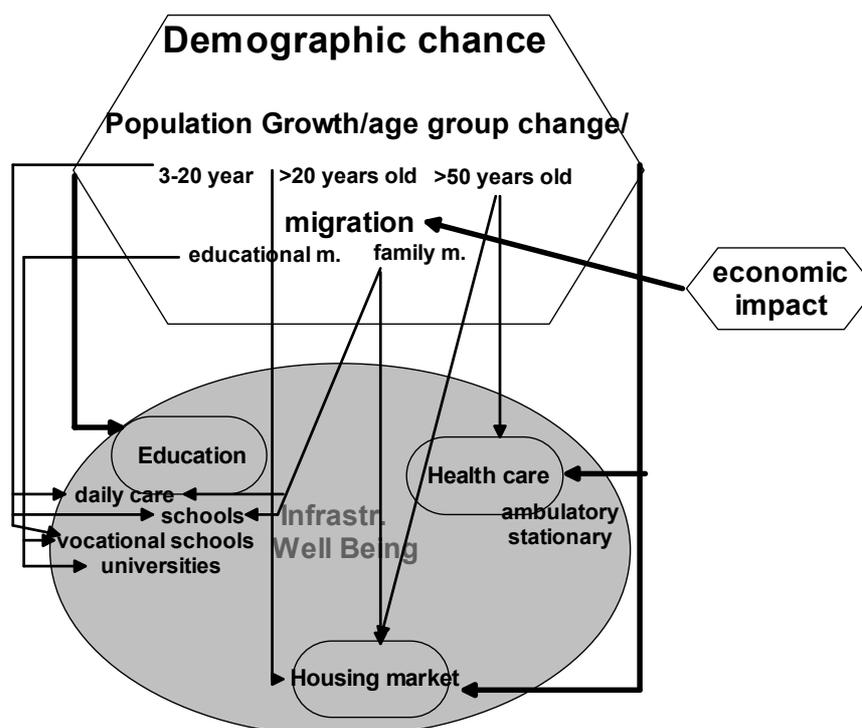


Figure 4: The influence of demography and economic development on the infrastructural well being

4 Discussion and conclusion

This paper shows an approach to describing elements of the social system in order to better track the effects of environmental change, the impacts of changes in sea and land use and the impacts of economic changes on a region. Social aspects are often neglected in comparison to the impacts of change on ecosystems and the economy. Using objective living conditions to describe the social system has the advantage that it is based on statistical and mostly available data (with the exception of data for leisure, security and transportation) and that the nomenclature is clear to decision makers and the public. For the implementation of scenarios terms and definitions need to be easy to understand. For some parts of infrastructural living conditions like education, housing market and health care lots of data are collected in surveys and statistics. The problem in this context is the lack of data at lower spatial levels and also the lack of criteria to describe and evaluate the situation of e.g. health care, leisure facilities, security or transportation. Further the approach could be described more as a qualitative temptation than a quantitative one. The determination of some values (for example the quantified value for “relaxed” housing market) is worth discussing. Nevertheless the description of well being and its changes should be strongly spotlighted than previously considered in the scenario technique.

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